

Serial Number: 09/838,493

Filing Date: April 19, 2001

Title: COMBINED BARRIER LAYER AND SEED LAYER

REMARKS

This responds to the Office Action mailed on May 17, 2004.

Claims 26, 32, 33, 44, 45, and 47 are amended, no claims are canceled, and no claims are added; as a result, claims 1-9, 11-14, 16-41, and 43-57 are now pending in this application. The amendments to the claims are fully supported by the specification as originally filed. No new matter is introduced. The amendments are made to clarify the claims. Applicant respectfully requests reconsideration of the above-identified application in view of the amendments above and the remarks that follow.

Claims 32, 33, 44, 45, and 47 are amended to include elements similar to elements of claim 1. Therefore, no additional search is required. Claim 33 is amended to follow the language of claim 32. Amendments to claim 26 also do not require an additional search. Applicant believes that claims are in condition for allowance.

§103 Rejection of the Claims

Claims 1-9, 11-14, 16-41, and 43-57 were rejected under 35 USC § 103(a) as being unpatentable over Lopatin et al. (U.S. Patent No. 6,555,909) in view of Chen (U.S. Patent No. 6,632,345). Applicant respectfully traverses these grounds for rejection of these claims.

Applicant reserves the right to swear behind Lopatin et al. (hereafter Lopatin) and Chen at a later date. Nevertheless, Applicant submits that the instant claims are distinguished from the combination of Lopatin and Chen.

Applicant cannot find in the combination of Lopatin and Chen a teaching or a suggestion of a method that includes “electrochemically reducing oxides on the surface of the dual-purpose layer using a first electrolyte where the first electrolyte includes a cation species of material of an anode in an electrochemical reaction cell” (underling added) as recited in claim 1. As stated in the Office Action, “Lopatin does not explicitly disclose electrochemically reducing oxides on the surface of the dual-purpose layer using a first electrolyte where the first electrolyte includes a cation species of material of an anode in an electrochemical cell.” Further, Lopatin also does not implicitly disclose elements of a method for electrochemically reducing oxides. Lopatin mentions electroless plating and electroplating for forming conductor material on seedless barrier

layers at column 5, lines 62 and electrochemical nucleation of such layers at column 6, lines 34-44. However, Lopatin does not provide details regarding electrochemical deposition of the conductor material or the nature of material used in an anode in an electrochemical cell.

The Office Action relies on Chen regarding elements for electrolytically depositing a metal stating “Chen discloses electrochemically reducing oxides on the surface of the dual-purpose layer using a first electrolyte where the first electrolyte includes a cation species of material of an anode in an electrochemical reaction cell.” Applicant disagrees. Among other things, Chen does not disclose the material of an anode and does not disclose a relationship between an electrolyte and the anode. Chen uses an alkaline electrolytic copper bath to enhance an ultra-thin copper seed layer that has been deposited on a barrier layer. *See Chen column 3, 33-45.* In addition, Chen uses an electroplating cell having an anode, reciting at column 5, 1-14:

A schematic representation of an apparatus 25 suitable for enhancing the ultra-thin copper seed layer is illustrated in FIG. 3. It will be recognized that this apparatus is also suitable for applying a blanket plating layer and/or full-fill plating of recessed micro-structures. As shown, a semiconductor workpiece, such as a semiconductor wafer 30, is positioned face-down in a bath 35 of electroplating solution. One or more contacts 40 are provided to connect the wafer 30 to a plating power supply 45 as a cathode of an electroplating cell. An anode 50 is disposed in the bath 35 and is connected to the plating power supply 45. Preferably, a diffuser 55 is disposed between the anode 50 and the wafer/cathode 30. The wafer 30 may be rotated about axis 60 during the enhancement process. Anode 50 may be provided with a dielectric shield 65 at a backside thereof that faces an incoming stream of plating bath fluid.

Applicant cannot find further discussion of an anode in Chen. As a result, Applicant cannot find in Chen a teaching or suggestion regarding the material of the anode. Thus, Chen does not cure the abovementioned deficiencies of applying Lopatin with respect to the elements of instant claim 1.

The combination of Lopatin and Chen does not teach or suggest a method that uses an anode that includes material, where a cation species of the material is used in the first electrolyte, as recited in claim 1. Therefore, the combination of Lopatin and Chen does not teach or suggest all the elements as recited in claim 1 and does not establish a proper *prima facie* case of obviousness with respect to claim 1. The reference (or references when combined) must teach or suggest all the claim elements. M.P.E.P. § 2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d

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1438 (Fed.Cir. 1991)). Thus, Applicant submits that claim 1 is patentable over Lopatin in view of Chen.

Claims 12, 25, 32 as amended, 44 as amended, 45 as amended, and 47 as amended, also recite elements dealing with the material of anode of an electrochemical cell and its relationship to an electrolyte. Since the combination of Lopatin and Chen does not teach or suggest the material of an anode or the relationship of a material of an anode with an electrolyte, the combination of Lopatin and Chen does not teach or suggest all the elements of claims 12, 25, 32, 44, 45, and 47. Thus, claims 12, 25, 32, 44, 45, and 47 are patentable over Lopatin in view of Chen.

As to claims 26 and 27, the Office Action states “Lopatin discloses wherein the anode comprises titanium (col. 6, lines 49-54) and Chen discloses wherein the first electrolyte comprises titanium trichloride, titanium sulfate, titanium bromide, titanium trichloride, titanium iodide, titanium fluoride, or mixtures thereof (col. 5, lines 15-48).” Applicant respectfully disagrees.

Claim 26 as amended recites “electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte,” “electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte,” and “the first electrolyte comprises titanium sulfate, titanium bromide, titanium trichloride, titanium iodide, titanium fluoride, or mixtures thereof.” As previously discussed, Lopatin does not teach or suggest details for electrochemically reducing oxides or details regarding electrochemically depositing a conductive material. Further, Chen at col. 5, lines 15-48 cited in the Office Action deals with a copper bath using copper sulfate. Chen does not teach or suggest a electrolyte of titanium sulfate, titanium bromide, titanium trichloride, titanium iodide, titanium fluoride, or mixtures thereof as recited in claim 26, as amended. Therefore, the combination of Lopatin and Chen does not teach or suggest all the elements of claim 26 and does not establish a *prima facie* case of obviousness with respect to claim 26. Thus, claim 26 is patentable over Lopatin in view of Chen.

Claim 27 recites “wherein the first anode is formed from titanium and the first electrolyte is titanium chloride or titanium sulfate.” As previously discussed, the combination of Lopatin and Chen does not teach or suggest the material of an anode and does not teach or suggest a

relationship between a material of an anode and an electrolyte. Thus, the combination of Lopatin and Chen does not teach or suggest a first anode formed from titanium where the first electrolyte is titanium chloride or titanium sulfate, as recited in claim 27. Further, at Lopatin column 6, lines 49-54 cited in the Office Action, Lopatin discusses titanium as a barrier layer on which a material may be deposited. Applicant cannot find a teaching or suggestion in Lopatin of anode comprising titanium or an electrolyte of titanium chloride or titanium sulfate. In fact, Applicant cannot find a teaching or suggestion of an anode in Lopatin. The details Lopatin do not have a teaching or suggestion of elements for electrochemically reducing oxides, as noted in the Office Action. Further, Chen at col. 5, lines 15-48 cited in the Office Action deals with a copper bath in which there is no mention of a titanium anode or an electrolyte of titanium chloride or titanium sulfate. Therefore, the combination of Lopatin and Chen does not teach or suggest a first anode formed from titanium and a first electrolyte of titanium chloride or titanium sulfate, as recited in claim 27. As a result, Lopatin in view of Chen does not teach or suggest all the elements of claim 27 and does not establish a *prima facie* case of obviousness with respect to claim 27.

Thus, claim 27 is patentable over Lopatin in view of Chen.

Applicant submits that the independent claims are patentable over Lopatin in view of Chen, and, therefore, the claims depending from these independent claims are patentable over Lopatin in view of Chen.

Applicant respectfully requests withdrawal of these rejections of claims 1-9, 11-14, 16-41, 43-57, and reconsideration and allowance of these claims.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney (612) 371-2157 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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Date 14 July 2004

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Mail Stop AF, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 17th day of July, 2004.

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